of Applicant's patent application. The reference indicated in the office action does not make Applicant's claimed invention obvious.

Applicant respectfully traverses the rejection of claims 11, 12, and 14-17 under 35 U.S.C. 103. The cited references do not include and do not suggest the teachings of Applicant's patent application. The references indicated in the office action do not make Applicant's claimed invention obvious.

The Office Action indicates that as to claims 1-11, 13, 18 and 19, "Shin teaches a method of providing a process chamber, generating a substantially hot wall process zone in the process chamber using substantially isothermal sections of electrical resistance strip heater, loading the wafer in the process zone, rotating the wafer, monitoring the temperature of the wafer while it is rotating, flowing a preheated gas over the wafer in a direction parallel to the wafer, inducing a velocity gradient in the direction of the gas flow and maintaining the gas in zones held at preselected temperatures until the gas exits the process chamber. "

However, a more detailed consideration of the disclosure of Shin shows that Shin does not describe nor suggest the teachings of Applicant's patent application. The teachings of Shin pertain to a horizontal reactor for compound semiconductor growth. Shin uses an apparatus as summarized in the office action. However, the office action does not fully describe the operation of the Shin apparatus and corresponding method and, consequently, does not fully describe the limitations and capabilities of the Shin apparatus and corresponding method.

In column 4 lines 66-67 Shin describes the inner cell of his apparatus as being "made from a quartz tube to avoid being heated by RF heater 12." Consequently, the apparatus of Shin does not have walls that are directly heated. Instead, the walls are heated indirectly from the heated susceptor and thus results in a temperature gradient between the walls and the susceptor. Shin teaches that the susceptor 6 admits the substrate 17 (column 3 lines 54-55), and in Fig. 1, Shin shows

the substrate 17 resting on the susceptor 6. The temperatures of the walls are lower than the temperature of the susceptor; the wall temperatures are not controlled and the process zone is not isothermal. Shin only teaches actively heating the susceptor and the gases; the heating of the process zone walls is merely a consequence of heating the susceptor. Shin does not teach and does not suggest controlling the temperature of the process zone walls and does not suggest providing an isothermal process zone. The apparatus taught by Shin is not capable of producing an isothermal process zone.

Analogously, in the second embodiment of the Shin reactor (see column 7 lines 59-67 and column 8 lines 1-2) Shin states that

> "the susceptor has a recess for laying a substrate on it. The susceptor is surrounded by a molybdenum plate 131 at its periphery and on its bottom surface. A plate-type heater 132 is located under the molybdenum plate with a gap. A PBN heater is used for plate-type heater 132. The molybdenum plate allows uniform heating of susceptor 130 by dispersing heat from plate-type heater 132. Heater 132 is surrounded by a reflecting plate 133 except at the portion facing the molybdenum plate. The reflecting plate efficiently focuses heat from the heater onto molybdenum plate 131 and avoids radiation to other portions of the reactor."

Similar to the first embodiment, Shin only teaches heating the gas and heating the wafer and explicitly teaches avoiding heating other portions of the reactor. Shin indicates no desire to achieve a hot wall process zone and no teachings or suggestion of producing an isothermal process zone.

Furthermore, in the second embodiment, Shin (column 7 lines 2-5) teaches providing the process gas at about 1000 degrees C and the susceptor temperature controlled at a suitable temperature below 1000 degrees C." Clearly, Shin is not teaching the use of an isothermal process zone.

Shin indicates that his system does not operate isothermally in Column 3 lines 31-34, where it is stated that

> "The inner cell is inclined above the suceptor and downwardly toward the gas outlet in order to suppress thermal convection attributed to heat from the suceptor which hinders smooth epitaxial growth."

Similarly, in Column 5, lines 21-26 Shin states

> "Inclined portion 4 is provided in the middle of inner cell 3 in order to eliminate thermal convection and to allow laminar flow to reach the substrate on which the GaN semiconductor growth process occurs, avoiding the adverse effects due to thermal convection from the high temperature of the susceptor. The inclined angle of inclined portion 4 is varied depending on the size of the substrate and drift velocity of the source gases, and is selected to form laminar flows above the substrate. By providing inclined portion 4 opposite the susceptor, the flow of source gases collides with inclined portion 4 and goes downward to the substrate in spite of the heating of source gases by hot substrate 17."

If the Shin reactor operated using an isothermal process zone, there would be no thermal convection to be eliminated because thermal convection can only occur in fluids when there are temperature gradients in a gravitational field. Shin also clearly states that the gases are heated by the hot substrate; this means that the gas temperature in the process zone is significantly different from that of the substrate and, as such, cannot be considered isothermal. Clearly, Shin teaches a reactor and corresponding method that operate in the presence of convection problems and, therefore, the process zone is not isothermal.

However, Claim 1 of Applicant's patent application is an independent claim that sets forth a method for thermally processing a semiconductor wafer. In one embodiment, the method comprises the steps of:

a. providing a process chamber;
b. generating a substantially isothermal hot wall process zone in the process chamber using substantially isothermal sections of electrical resistance strip heaters;
c. loading the wafer in the process zone;
d. rotating the wafer;
e. flowing a preheated gas over the wafer in a direction substantially parallel to the wafer surface;
f. inducing a velocity gradient in the preheated gas so that the velocity of the gas increases in the direction of the gas flow; and
g. maintaining the gas in zones held at preselected temperatures until the gas exits the process chamber.

In other words, Applicant's method claim describes the use of an isothermal hot wall process zone, substrate rotation, and a gas velocity gradient for processing the substrate. As explained above, Shin teaches an apparatus capable of producing substrate rotation, a gas velocity gradient, and substrate heating. Applicant's teachings differ from that of Shin by also teaching the use of an isothermal hot wall process zone; Shin does not teach nor does he suggest the use of an isothermal hot wall process zone. The results that can be obtained with Applicant's teachings differ from the results that can be obtained using the teachings of Shin. In fact, the configuration of Shin's apparatus cannot be used to practice Applicant's teachings; it would be necessary to redesign Shin's apparatus in ways that are not disclosed and are not suggested by Shin's teachings. This means that the apparatus and corresponding method of Shin are different from that of Applicant's teachings. In addition, Applicant's teachings would not be obvious to one of ordinary skill in the art in view of Shin.

Shin disclosed an apparatus that is not capable of providing the process temperature conditions of an isothermal hot wall process zone. Because of the absence of hot wall isothermal process conditions, the apparatus of Shin does not include the functionality taught by Applicant's invention. In fact, the apparatus taught by Shin suffers from the added problem of convection that results from using non-isothermal process conditions

and Shin indicates no dissatisfaction with the solutions he teaches. In addition, the cited reference provides no suggestion or motivation for making the modifications necessary to obtain Applicant's teachings of using an isothermal hot wall process zone along with the other limitations recited in Applicant's claims. As such, the rejections under U.S.C. 102e should be withdrawn. Specifically, the requirements for a rejection under U.S.C. 102 are not met because Applicant's teachings and Shin's teachings are different.

Claim 8 of Applicant's patent application is an independent claim that sets forth a method. In one embodiment, the method involves the steps of:

a) providing a process chamber;
b) enclosing the process chamber in a substantially cold-wall housing;
c) generating a substantially isothermal hot wall process zone in the process chamber using substantially isothermal sections of electrical resistance strip heaters and measuring temperatures at multiple locations on at least one of heaters and wall of the process chamber to control the temperature of the process zone;
d) restricting heat loss from the heaters and process chamber;
e) loading the wafer into the process zone;
f) rotating the wafer;
g) monitoring the temperature of the wafer by measuring the temperature at multiple locations on the wafer while the wafer is rotating;
h) flowing a preheated gas over the wafer in a direction substantially parallel to the wafer surface;
i) inducing a velocity gradient in the preheated gas so that the velocity of the gas increases in the direction of the gas flow;

j) capturing substantially all process gas leakage from the process chamber; and

k) maintaining the gas in zones held at preselected temperatures until the gas exits the process chamber.

Please note that step c of Applicant's claim 8 recites "generating a substantially isothermal hot wall process zone." In other words, step c) of Applicant's independent claim 8 distinguishes Applicant's teachings from that of Shin in the same manner that Applicant's claim 1 distinguishes over the teachings of Shin. Shin does not teach and does not suggest the use of a substantially isothermal hot wall process zone. In other words, the teachings of Shin do not describe and do not suggest the teachings of Applicant's invention. As such, withdrawal of the 35 U.S.C. 102e rejection of independent claim 8 is respectfully requested.

Claim 9 of Applicant's patent application is an independent claim that sets forth a combination of method steps. In one embodiment, the method involves the steps of:

a) containing a wafer in a substantially isothermal process zone;

b) rotating the wafer within the process zone;

c) monitoring the temperature of the wafer while the wafer is rotating;

d) flowing a preheated gas over the wafer in the process zone in a direction substantially parallel to the wafer surface;

e) inducing a velocity gradient in the preheated gas so that the velocity of the gas increases in the direction of the gas flow as the gas passes over the wafer.

Please note that step a) of Applicant's claim 9 recites "containing a wafer in a substantially isothermal process zone." In other words, step a) of Applicant's independent claim 9 distinguishes Applicant's teachings from that of Shin in the same manner that Applicant's claim 1 and claim 8 distinguish over the teachings of Shin. Shin does not teach and does not suggest the use of a substantially isothermal process zone. Shin clearly describes a non-isothermal process zone in which it is

expected that the substrate temperature, the gas temperature in the process zone, and the temperature of the walls of the process zone are different, i.e., not isothermal. Unlike the teachings of Shin, the methods taught by Applicant do not have the limitations of Shin. The teachings of Shin do not describe and do not suggest to a person of ordinary skill in the art the teachings of Applicant. As such, withdrawal of the 35 U.S.C. 102e rejection of independent claim 9 is respectfully requested.

Claim 20 of Applicant's patent application is an independent method claim for thermally processing a wafer using step plus function language. In one embodiment, the method involves:

a) step for maintaining the wafer at a substantially isothermal temperature;
b) step for rotating the wafer for improved heat and mass transfer uniformity;
c) step for inducing a gas flow having a velocity gradient above the surface of the wafer for improved heat and mass transfer uniformity for the surface of the wafer;
d) step for controlling the temperature of the gas so as to reduce the amount of cooling of the wafer by the gas;
e) step for controlling the temperature of the gas so as to substantially prevent deposition of non-adherent layers that cause particle contamination of the wafer.

Please note that step a) of Applicant's claim 20 recites "step for maintaining the wafer at a substantially isothermal temperature." Since step a) of Applicant's claim 20 uses step plus function language, Applicant respectfully requests reconsideration of claim 20 under the rules of the Manual of Patent Examination Procedures 2181, Identifying a 35 U.S.C. 112, Sixth Paragraph Limitation [R-1] which states

> "... in Donaldson, the Federal Circuit stated:
> Per our holding, the "broadest reasonable interpretation" that an examiner may give means-plus-function language is

> that statutorily mandated in paragraph six. Accordingly, the PTO may not disregard the structure disclosed in the specification corresponding to such language when rendering a patentability determination."

Applicant's specification provides one or more descriptions for each of the means plus function claim elements of claim 20 for one or more embodiments of Applicant's invention.

As seen in Applicant's remarks, supra, about Applicant's claims 1, 8, and 9, Applicant's teachings are different from that of Shin and Applicant's teachings are not anticipated by Shin. Applicant's specification teaches using an isothermal process zone in embodiments presented therein. Shin does not teach the use of an isothermal process zone. As stated earlier, Shin clearly describes a non-isothermal process zone in which it is expected that the substrate temperature, the gas temperature in the process zone, and the temperature of the walls of the process zone are different, i.e., not isothermal. Shin's teachings are not conducive to or are incapable of maintaining the wafer at a substantially isothermal temperature. However, using an isothermal process zone as taught by Applicant is highly conducive to maintaining the wafer at a substantially isothermal temperature. As such, withdrawal of the 35 U.S.C. 102e rejection of independent claim 20 is respectfully requested.

The arguments presented supra for withdrawal of the 35 USC 102e rejections show that Applicant's invention is not anticipated by Shin because Applicant's teachings distinguish over the teachings of Shin. Since Shin does not anticipate Applicant's invention, it is inappropriate to reject Applicant's claims 11, 12, and 14-17 under 35 USC 103(a) as being unpatentable over Shin in view of Dietz et al. (US Patent 5,685,906) because the teachings of Dietz et al. which includes supplying a gas containing silicon to deposit silicon does not describe and does not suggest Applicant's invention as presented in claims 11, 12, and 14-17. In other words, Applicant's invention is not obvious because Applicant's claims distinguish over Shin and adding the teachings of Dietz et al. does not provide the additional teachings needed to be equivalent to or

suggestive of Applicant's teachings. More specifically, Dietz et al. only adds the teachings of depositing silicon and does not add teachings of using an isothermal process zone or the teachings of using an isothermal hot wall process zone to the teachings of Shin as would be needed to anticipate and make Applicant's invention obvious.

The teachings of Shin in view of Dietz et al. abide by the "then-accepted wisdom in the art," whereas, Applicant's teachings were non-obvious and unrealized by anyone of ordinary skill in the art. Based on Shin, the accepted wisdom at the time of Applicant's invention was to allow a more limited operability and lower performance because of failure to use teachings such as an isothermal process zone and other limitations recited in Applicant's claims. Consequently, further justification for the withdrawal of the rejection under 35 U.S.C. 103(a) becomes apparent upon applying the standards set out in the Manual of Patent Examining Procedures, section 2141.01 III, which states:

> "It is difficult but necessary that the decision maker forget what he or she has been taught... about the claimed invention and cast the mind back to the time the invention was made..., to occupy the mind of one skilled in the art who is presented only with the references, and who is normally guided by the then accepted wisdom in the art."

In light of the above remarks, withdrawal of the rejection of claims 11, 12, and 14-17 under 35 U.S.C 103(a) is respectfully requested.

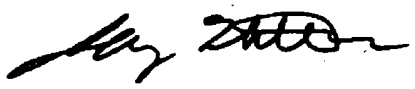
Additional support for the novelty and non-obviousness of Applicant's invention can be seen in recent experimental data collected using an embodiment of Applicant's invention. Test results for the embodiment show silicon deposition rates of 3.8 micrometers per minute using $SiHCl_3$ at 1070 degrees C. However, in a cold wall reactor, a temperature of 1170 degrees C is believed required. Applicant believes that the higher rate at lower temperature is an effect of using a hot wall process chamber so that the surface of the wafer is not radiating to a cold wall. This embodiment of Applicant's isothermal process zone reduces crystal slip for epitaxial silicon deposition.

Applicant has shown that independent claims 1, 8, 9, and 20 describe embodiments of Applicant's invention that are not described and not suggested by Shin. In addition, Applicant has shown that independent claims 1, 8, 9, and 20 describe embodiments of Applicant's invention that are not described and not suggested by Shin in view of Dietz in combination with the knowledge of one of ordinary skill in the art. As such, withdrawal of the rejections of independent claims 1, 8, 9, and 20 under 35 U.S.C. 102e and withdrawal of the rejection of dependent claims 11, 12, and 14-17 under 35 U.S.C. 103(a) are respectfully requested. Upon withdrawal of the rejections of independent claims 1, 8, and 9, Applicant respectfully requests withdrawal of the rejections of dependent claims 2-7, 10, 13, 18, and 19 as they now depend from allowable independent claims 1, 8, and 9 and add further limitations and/or further description.

In view of the foregoing remarks, further and favorable action in the form of a notice of allowance for all 20 of the submitted claims is believed to be next in order, and such action is earnestly solicited.

Please telephone the undersigned at (408) 396-1112 if there are any questions regarding this matter.

Respectfully submitted,



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